

Western Electric Company, Inc.,
Equipment Engineering Branch,
Hawthorne.

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Issue 2 - BT-501048,
July 27, 1923. (*)
Replacing all previous issues. (*)

This M. of O. prepared from issue 10 of T-501048.

METHOD OF OPERATION
INCOMING TRUNK SENDER.

For calls from Automatic Office and Manual Operator Panel Machine Switching system.

DEVELOPMENT

1. POPOSE OF CIRCUIT

This circuit is used for passing calls from an automatic office, from a manual operator, or from a toll operator, to subscribers whose lines terminate in a full mechanical power driven office. It is used in connection with incoming selector circuits which register the thousands digits of the number dialed.

2. WORKING LIMITS

None.

OPERATION

3. PRINCIPAL FUNCTIONS

This circuit receives the register impulses of the hundreds, tens, and units digits sent in from the subscriber or operator's dial and also registers the setting of the thousands digit received from the incoming circuit. It also controls the selection of the incoming and final selectors by means of counting relays.

4. CONNECTING CIRCUITS

This sender will function with:

- 4.1 Two wire incoming selector circuits, dialing from automatic office and manual "A" operator.
- 4.2 Two wire incoming selector, dialing from toll operator.
- 4.3 Three wire incoming selector, dialing from manual "A" operator.

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DESCRIPTION OF OPERATION

THOUSANDS, HUNDREDS, TENS AND UNITS REGISTRATION

5. SEIZURE

When the switch of an incoming selector to which a subscriber's or operator's dial circuit is connected, has selected this sender, ground on the test switch is connected to the T lead of the sender circuit operating the (H) relay, which supplies ground to light the sender busy (SB) lamp and to the locking contacts of the register relays (IB), (IB-1), (IB-2) and (IGT), and closes a circuit to the "All Senders Busy Register". As soon as the thousands register in the incoming selector circuit has been set, battery from the incoming selector circuit, over the REG, FT and FR leads, operates some combination of the (IB), (IB-1), (IB-2) and (IGT) relays, depending upon the setting of the thousands register. The pulsing circuit is then transferred from the incoming selector circuit to the sender circuit. As the pulsing relay in the incoming selector alternately releases and reoperates under control of the impulse from the dial, ground is intermittently connected over lead I, thereby stepping the HU register to the desired position. The (B) relay operates to ground in the incoming selector circuit over lead I. The (B) relay operated, supplies an additional ground to the stepping magnet to make the action of the stepping magnet more certain. The (B) relay releases every time the stepping magnet operates and reoperates as soon as the stepping magnet releases, until each series of impulses is completed. The (P) relay operates on the first impulse and being slow in releasing, remains operated until the series of impulses corresponding to any digit is completed. The (P) relay operated, prevents the operation of the (TR) relay until the HU registration has been completed. When hundreds registration has been completed, the (TR) relay operates to ground on cam N. The (TR) relay operated, transfers the pulsing circuit to the T-STP magnet so that the next set of impulses will advance the tens register. When the tens digit is dialed, the (P) relay again operates and holds until the tens registration is completed in a similar manner to that in which the hundreds registration was made. The (P) relay releases and allows the operation of the (TR-1) relay. The (TR-1) relay operated, transfers the pulsing circuit to the U-STP magnet, so that the series of impulses corresponding to the units digit of the called number will advance the units register.

6. INCOMING BRUSH SELECTION

When the (P) relay operates on the first pulse of the series corresponding to the hundreds digit, the (CI) relay operates to ground through cam N and locks to ground on its own armature. The (CI) relay operated, operates

the R magnet, advancing the sender switch to position 2. The (CI) relay releases as soon as the switch advances from position 1. The sender is now ready for brush selection on the incoming selector. In position 2 ground is connected through cam K over lead CI to the selector circuit, operating certain relays in the selector circuit thus closing a fundamental circuit from battery through one winding of the (L) relay (not shown) in the selector circuit, over the FT lead through the lower contact of cam E to 18 BH resistance windings of the stepping relay and the (OFL) relay break contact of the (BD) relay, cam D back over the FR lead to ground in the selector circuit, operating the (L) relay in the incoming selector and the stepping relay in the sender circuit. The operation of the (L) relay advances the incoming selector to the incoming brush selection position. The stepping relay operated, closes a circuit from ground through cam K, make contact of the stepping relay, cams J, and H, break contacts of the (IB-1) and (IB-2) relays, winding of one of the counting relays, to battery. The operation or non-operation of any of the (IB), (IB-1) and (IB-2) relays, in any particular case, determines which one of the counting relays is the first to be operated. Assume the 3 counting relay operated, closes a circuit which operates the (3') counting relay when the (STP) relay releases. As the selector elevator travels upward, ground is intermittently connected to the lead FT through the metal segments of the "A" commutator, thereby short circuiting and releasing the (STP) relay. The (STP) relay released, removes the short circuit from the winding of the (3') counting relay. The (3') counting relay operates, locking both (3) and (3') counting relays. The (3') counting relay operated, transfers the operating circuit for the (3) counting relay to the (2) counting relay. As soon as the A brush has passed the first metal segment on the A commutator, the (STP) relay reoperates, closing the circuit from ground on the K cam through its contacts to the (2) counting relay. The (2), (1) and (0) counting relays are therefore operated in succession as the (STP) relay alternately operates and releases. When the (STP) relay next releases after the (0) counting relay is operated, the (BO') and (FO') relays operate in parallel and lock in series with the winding of the (0) counting relay, to ground on cam F. The (BO') relay operated, opens the fundamental circuit, preventing the reoperation of the (STP) relay and releasing the (L) relay in the incoming selector circuit. The release of the (L) relay advances the selector and releases the up drive magnet, thereby stopping the upward movement of the selector. The (FO') relay operated, operates the R magnet, advancing the sender switch to position 3. The counting relays which were operated and the (BO') and (FO') relays release when the switch advances from position 2.

7. INCOMING GROUP SELECTION

If the HU register has not been advanced, the sender waits in position

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3 until the HU registration is completed and the (P) relay has released. With the (P) relay released, the (CI) relay operates in a circuit from battery, cam I to ground on the HU-2 register. The (CI) relay operated, locks to ground on its armature and advances the sender switch to position 4 for Incoming Group selection. The (CI) relay releases when the sender switch advances from position 3. With the sender in position 4, the fundamental circuit is again closed and the (L) relay in the incoming selector and the (STP) relay in the sender circuit operate. The incoming selector advances to the "Incoming Group Selection, causing the UP magnet to energize and move the selection upward for group selection. Group selection is completed in a similar manner to brush selection as described in paragraphs 8, 9 and 10 with the exception that (a) the counting relay which is first operated depends on the setting of the HU register and on the operation or non-operation of the (IGT) relay (b) the lead FT is connected to the B commutator instead of to the A commutator. At the completion of group selection, the (BO') relay operated, opens the fundamental circuit, releasing the (L) relay in the incoming selector circuit. The (FO') relay operated, advances the sender switch to position 5, the A cam advancing it to position 6, for Final Brush selection. As the switch advances from position 4, the operated (IB), (IB-1), (IB-2) and (IGT) relays, the counting relays and the (BO') and (FO') relays release.

8. FINAL BRUSH SELECTION

When the incoming selector selects an idle trunk and advances to its "Selection Beyond" position, with the sender in position 6, the fundamental circuit is closed over lead FT, operating the (STP) relay in the sender circuit. The operation of the final (L) relay advances the final to the "Brush Selection" position. The selector moves upward and final brush selection is completed in a similar manner to incoming brush selection with the exception that the setting of the PU register controls which counting relay is the first to be operated. At the completion of brush selection, the (BO') relay operated, opens the fundamental circuit, causing the (L) relay in the final selector to release. The (FO') relay operated, advances the sender switch to position 7, ("Awaiting Tens Register"). The counting relays which were operated and the (BO') and (FO') relays release when the switch advances from position 6.

9. FINAL TENS SELECTION

When the (L) relay in the final selector releases after final brush selection is completed the incoming switch advances to the "Awaiting Sender" position. If the tens registration has not been completed, the sender waits in position 7 until tens registration is completed and the (P) relay is released. When the (P) relay releases, the (CI) relay

operates to ground on the T-2 register contacts, and locks to ground on its armature. The (CI) relay operated, advances the sender switch to position 8 for "Final Tens" selection. The (CI) relay releases when the sequence switch advances from position 7. The final selector also advances to "Tens Selection" when the (L) relay in the final selector and the (STP) relay in the sender circuit operate in fundamental circuit with the switch in position 8. Tens selection is completed in a similar manner to "Incoming Group" as described in paragraphs 11 and 12 with the exception that the setting of the tens register determines which counting relay is the first to be operated. At the completion of tens selection, the (BO') relay operated, opens the fundamental circuit, causing the (L) relay in the final selector to release. The (FO') relay operated, advances the sender switch to position 9 ("Awaiting Units Register"). The counting relays which were operated and the (BO') and (FO') relays release when the switch advances from position 8.

10. FINAL UNITS SELECTION

When the (L) relay (not shown) in the final selector releases after the final tens selection is completed, the final switch advances to the "Awaiting Sender" position. If the units register has not been advanced, the sender waits in position 9 until "Units Registration" is completed and the (P) relay has released. As soon as the units register advances beyond the normal position, the (RS) relay operates in a circuit from battery through its windings in series cam L to ground on the terminals of the U-2 register. With the (P) relay released, the (CI) relay operates from battery through cam I, winding and break contact of the (CI) relay, break contact of the (P) relay, inner contacts of cam C, to ground on the terminals of the U-5 register and locks to ground on its armature. The HU register now advances to normal in a circuit from battery through the 44-A resistance, winding and break contact of the HU-STP magnet, contact of the HU-1 register, cam O, make contact of the (RS) relay, to ground. When the HU register returns to normal, the circuit through the winding of the (TR) relay is opened and the (TR) relay releases. After the HU register has advanced to normal, the tens register is advanced to normal in a circuit similar to that for the HU register. When the tens register returns to normal, the circuit through the winding of the (TR-1) relay is opened at the contacts of the T-1 register and the (TR-1) relay releases. The units register cannot return to normal until the (RS) relay releases in position 13 of the sender sequence switch. The (CI) relay operated, advances the sender switch to position 10 for "Final Units" selection. The (CI) relay releases when the sequence switch advances from position 9. With the sender in position 10, the fundamental circuit is closed, operating the final (L) relay and the (STP) relay in the sender. With the (L) relay operated, the final selector advances to the final units selection po-

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sition and the incoming selector moves upward. The alternate release and reoperation of the (STP) relay is controlled by the U commutator. The setting of the Units register determines which counting relay is the first to be operated. At the completion of units selection, the operation of the (BO') relay opens the fundamental circuit, releasing the (L) relay in the incoming selector. The (FO') relay operated, advances the sender switch to position 11, the A cam advancing it to position 13. The counting relays which were operated and the (BO') and (FO') relays release when the switch advances from position 10.

11. RESTORING TO NORMAL

When the final units selection is completed, the final selector advances to the talking or to the busy back position according to whether the called line was idle or busy. In either case the incoming selector advances to the "Awaiting Sender" position and closes a circuit from battery through a winding of the incoming (L) relay over lead FR, cam D, break contact of the (BO') relay, windings of the (OFL) and (STP) relay, 18 BH resistance, cam E, lead FT to ground in the incoming circuit, operating the incoming (L) relay and thereby advancing the incoming to the "Awaiting Trunk Closure" position. In this position, the incoming selector disconnects ground from the T lead, releasing the sender. When ground is disconnected from lead T, the short circuit is removed from the 80 ohms winding of the (TB) relay, allowing it to operate in series with the (H) relay. The (TB) relay operated, locks to ground on its make contact from battery on cam I and opens the circuit through winding of the (H) relay, releasing the (H) relay. The ground on the (TB) relay makes the sender test busy until the switch advances to the normal position. The (H) relay released, releases the (RS) relay which closes a circuit from battery through the 44-A resistance, winding and break contact of the units stepping magnet, contacts of the U-1 register, break contact of the (RS) relay, normal contact of the T-1 and HU-1 registers, break contact of the (H) relay to ground, advancing the units register to normal. With the units register normal, a circuit is closed from battery through the R magnet and cam B, normal contact of the U-1 register, break contact of the (RS) relay, normal contacts of the T-1 and HU-1 registers, break contact of the (H) relay, to ground, advancing the sender sequence switch to position 1. As the sender switch advances from position 18 1/4, the locking circuit through the windings of the (TB) relay is opened at cam I, releasing the (TB) relay. The (TB) relay released, removes the busy condition from the T lead, restoring the circuit to normal. When a plug is inserted in the MB jack or when the motor stop alarm operates, a circuit is closed operating the (MB) relay. The (MB) relay operated, closes a circuit to the "All Sender Busy Register"

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and connects ground to lead T, thus making the sender test busy to all hunting selectors. When the plug is removed from the MB jack or the motor stop alarm is restored, the (MB) relay releases, restoring the circuit to normal.

ENC-B. F. M.
8-3-23.

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C O P Y

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CIRCUIT REQUIREMENTS

MECHANICAL REQUIREMENTS

207-A Armature gap .013" to .014".
(STP)
 Contact gap .003" to .004".

208-B Armature gap .018" to .021".
(prime count-
ing relays) Contact gap .004" to .005".

208-C
(BO', FO') The retractile spring tension shall be adjusted by
208-G bending the stationary lug on the relay frame and not
(Counting by bending the lug on the armature. In making this
relays) adjustment the stationary lug shall not be bent to
 an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

OPERATE

NON-OPERATE

RELEASE

178-AD- After a soak of ap-
(P) proximately .9 amp.
Wdgs. in Test .113 amp.
parallel Readj. .107 amp.

After a soak of
approximately
.9 amp. On
open circuit.

207-A Test .010 amp.
(STP) Readj. .0098 amp.

Test .009 amp.
Readj. .0092 amp.

208-B Test .0152 amp.
(prime Readj. .0148 amp.
counting
relays)
1' to 9'

Test .0138 amp.
Readj. .0142 amp.

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	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
208-C (B) (FO)	Through relay winding: Readj. .0118 amp.	Through relay winding: Readj. .0112 amp.	
	Through parallel combination: Test .0244 amp. Readj. .0236 amp.	Through parallel combination: Test .0216 amp. Readj. .0224 amp.	
208-G (counting relays 0 to 9)	Test .0152 amp. Readj. .0148 amp.	Test .0138 amp. Readj. .0142 amp.	
E635 (RS)	Test .019 amp. Readj. .016 amp.	Test .0085 amp. Readj. .009 amp.	
E739 (CI)	Test .028 amp. Readj. .013 amp.		Test .0019 amp. Readj. .002 amp.
E818 (IB) Inner Wdg. 110 ohms.	Test .071 amp. Readj. .067 amp.	Test .042 amp. Readj. .045 amp.	
Outer Winding 1000 ohms.	Test .054 amp.		HOLD: Test .040 amp.
E828 (B)	Armature travel .015" Test .010 amp. Readj. .0095 amp.	Test .006 amp. Readj. .0065 amp.	
E918 (IB-2) (IGT) Inner (1000 ohms)	Test .038 amp. Readj. .033 amp.	Test .019 amp. Readj. .020 amp.	
Outer (1000 ohms)	Test .038 amp.		
E1008 (MB)	Test .019 amp. Readj. .016 amp.	Test .0085 amp. Readj. .009 amp.	

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CIRCUIT REQUIREMENTS

	<u>OPERATE</u>	<u>NON-OPERATE</u>	<u>RELEASE</u>
E1250 (TB) Inner (80 ohms)	Test .038 amp. Readj. .036 amp.		Test .0076 amp. Readj. .008 amp.
E1261 (TR) (TR-1) Inner (1000 ohms)	Test .020 amp. Readj. .018 amp.		Test .0028 amp. Readj. .003 amp.
E1314 (H)	Test .032 amp. Readj. .022 amp.	Test .0095 amp. Readj. .010 amp.	
E1415 (IB-1) Inner (250 ohms)	Test .0252 amp. Readj. .024 amp.	Test .014 amp. Readj. .015 amp.	
Outer (1000 ohms)	Test .058 amp.		HOLD: Test .0315 amp.

ENG.-ROC-JO.
500-8-17-22
125-6-30-22

CHK'D-WCD-CWP.

APPROVED-C.L.SLUYTER-G.M.L. KX.

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